

# PATENT SPECIFICATION (11)

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## (54) A SPRING RING

(71) We, FORD MOTOR COMPANY LIMITED, of Eagle Way, Brentwood, Essex CM13 3BW, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a spring ring made of circular-section wire, for shafts and bores, which is arranged in a locating groove in the shaft or in the bore, in a radially compressed or radially expanded state as the case may be and when thus arranged enables a corresponding machine component to be fitted in position by sliding it axially past the ring, when the ring is radially relaxed it engages in a locking groove in the machine component and secures the latter axially in position.

Spring rings or circlips made of circular-section wire, i.e. rings of the kind introductorily described, are well known. If standard circular wire spring ring of this kind is arranged in a locating groove of greater radial depth, a machine component can be assembled on a shaft or in a bore by sliding it past the previously inserted spring ring. This kind of assembly sequence is required in installation where subsequent insertion of the circular wire spring ring is not possible due to lack of access.

When using standard circular wire spring rings, difficulties have been encountered in the assembly of the machine component because the spring ring has moved into a radially one-sided position in its deep locating groove. In order to slide the machine component requiring assembly, past the ring, the latter had to be aligned concentrically with its locating groove, using additional aids. Further difficulties have arisen in operation because the security of the machine component against axial displacement, following the assembly of the component and the engagement of the spring ring in the detent, groove, was not always entirely adequate.

According to the present invention there is provided a spring ring made of circular-section wire suitable for securing a first component including a shaft or cylindrical member in a corresponding bore provided in a second component, one of said components having a locating groove for retaining the spring ring and the other component having a locking groove so that on sliding said shaft or cylindrical member axially relative to said bore during assembly operation of said components, the spring ring fully retracts into the locating groove and when said locating groove and said locking groove are aligned with one another the spring ring in the locating groove is radially relaxed and engages the locking groove thereby securing together said components, the free end portions of the ring being bent inwardly or outwardly in such a way that they seat against the base of the groove holding the ring substantially concentric in relation to the locating groove, the two bent end portions together constituting about one tenth of the circumferential length of the ring.

By bending the ends of the circular wire spring ring over about one tenth of the ring length inwardly for a shaft and outwardly for a bore, in such a manner that the ends support the spring ring substantially concentrically in relation to the locating groove by resting upon the groove base, the difficulties which are encountered with the known kinds of circular wire springs rings are avoided.

Because of the fact that the circular wire spring ring on insertion into its locating groove, is positioned substantially concentrically there, it is possible to slide the machine component which is to be assembled and secured in position, into position quite simply without the need for any additional aids. Moreover, the same measure achieves the requisite increase in security against axial displacement when any axial forces are developed on the component, since the force required for axial displacement, which was hitherto solely determined by the resistance of the spring ring to radial compression

sion under the influence of a chamfer provided for the purposes of dismantling of the component, is now reinforced by the resistance required to bend back the bent spring ring ends located against the base of the groove. The resistance offered by a circular spring ring embodying the invention, to an axial displacement, is in this way increased by about three times in comparison with a known, standard wire spring ring.

Thus, the circular wire spring ring in accordance with the invention not only enables easier assembly to be carried out in difficult installation situations, as for example when securing half-shaft bevelled gears of a differential gearing system of a motor vehicle, to the half-shaft ends, the latter being extremely difficult to get at because of their arrangement in the differential gear casing but also ensures more reliable operation because, through the increased axial resistance offered by the circular wire spring ring embodying the invention, inadvertent, automatic dismantling of the circular wire spring ring arrangement is prevented.

The invention will now be described by way of example with reference to the accompanying drawings in which:—

Figure 1 illustrates a vertical section through a circular wire spring ring arrangement in accordance with the invention, as well as a corresponding vertical section through a locating groove provided on a shaft and a locking groove formed in a corresponding bore in a machine component.

Figure 2 illustrates similar sections to that of Figure 1, taken during the assembly operation, of the circular wire spring arrangement;

Figure 3 illustrates a vertical section through another embodiment of the circular wire spring ring arrangement in accordance with the invention, as well as a vertical section through a locating groove provided in a bore in a machine component and a locking groove formed on a shaft; and

Figure 4 illustrates similar sections to that of Figure 3, taken during the assembly operation of the circular wire arrangement.

In Figures 1 and 2, a shaft 1 is provided with a locating groove 2 for a circular wire spring ring 3. A machine component 4 intended to be axially secured upon the shaft 1, is provided with a bore 5 to accept the shaft 1. The bore 5 contains a locking groove 6 for the spring ring 3.

The locating groove 2 in the shaft 1 has a radial depth such that the circular wire spring ring 3 can retract fully into the groove 2 during the assembly operation (see Figure 2).

The assembly of the machine component 4 on the shaft 1 is here performed by axially inserting the shaft 1 in the direction of the

arrow X, a chamfer 7 provided at the entry side of the bore 5 deflecting the circular wire spring ring 3 completely into its locating groove 2. As soon as the locating groove 2 and the locking groove 6 come into alignment with one another, the spring ring 3 expands and virtually the whole of its external periphery moves into contact with the base of the locking groove 6. The depth of the locking groove 6 must be so contrived in this context that not only is the component reliably axially secured but also facility for dismantling retained, by an operation of axial withdrawal.

The dismantling of the machine component 4 is here performed by axially withdrawing the shaft 1 in the direction of the arrow as shown in Fig. 2. The bore 5 is provided with a chamfer 8 in order to completely deflect the circular wire spring ring 3 into its locating groove 2 as soon as the extraction force has become sufficiently high.

The angles  $\alpha$  and  $\beta$  of the chamfers 7 and 8 at the entry side of the bore 5 and the extraction side of the locking groove 6 respectively, must here be chosen in accordance with the desired axial resistance and the requisite dismantling force.

In accordance with the invention, the two end portions 9 of the circular wire spring rings 3 are bent inwardly in such a way that they seat against the base of the locating groove 2, and hold the spring ring 3 substantially concentric in relation to the groove. The two bent end portions 9 together constitute about one tenth of the circumferential length of the ring.

Figures 3 and 4 show a machine component 4<sup>1</sup> containing a bore 5<sup>1</sup> provided with locating groove 2<sup>1</sup>. A shaft 1<sup>1</sup> which is to be secured in position in the machine component 4<sup>1</sup>, a diameter corresponding to the bore 5<sup>1</sup> and a locating groove 6<sup>1</sup> for the circular wire spring ring 3<sup>1</sup>.

The locating groove 2<sup>1</sup> in the bore 5<sup>1</sup> has a radial depth such that the circular wire spring ring 3<sup>1</sup> can retract fully into the locating groove 2<sup>1</sup> during the assembly operation (see Figure 4).

The assembly of the shaft 1<sup>1</sup> in the bore 5<sup>1</sup> of the machine component 4<sup>1</sup> is effected by sliding the shaft 1<sup>1</sup> axially in the direction of the arrow X, the chamfer 7<sup>1</sup> provided upon the entry side of the shaft 1<sup>1</sup> causing the circular wire spring ring 3<sup>1</sup> to retract fully into its locating groove 2<sup>1</sup>. As soon as the locating groove 2<sup>1</sup> in the bore 5<sup>1</sup> and the locking groove 6<sup>1</sup> in the shaft 1<sup>1</sup>, move into alignment with one another, the spring ring 3<sup>1</sup> relaxes and its internal periphery seats against the base of the locking groove 6<sup>1</sup>. The depth of the locking groove 6<sup>1</sup> must again be so chosen that the requisite axial resistance is created but also the facility for dismantling by axial extraction retained.

5 Dismantling of the shaft 1<sup>1</sup> from the bore 5<sup>1</sup> is performed by axially withdrawing it in the direction of the arrow Y, as shown in Figure 4, a chamfer 8<sup>1</sup> formed on the extraction side of the locking groove 6<sup>1</sup>, causing the spring ring 3<sup>1</sup> to retract completely into its locating groove 2<sup>1</sup> as soon as the axial dismantling force becomes sufficiently high.

10 The angles a and b of the chamfers 7<sup>1</sup> and 8<sup>1</sup> at the entry side of the shaft 1<sup>1</sup> and the extraction side of the locking groove 6<sup>1</sup>, respectively, must once again be chosen to accord with the desired axial resistance on the one hand and the requisite dismantling force on the other.

15 In accordance with the invention, the two end portions 9<sup>1</sup> of the spring ring 3<sup>1</sup> have been bent outwardly in such a manner that they seat against the base of the locating groove 2<sup>1</sup> and hold the spring ring 3<sup>1</sup> substantially concentric in relation to the groove. The two bent end portions together constitute about one tenth of the circumferential length of the ring.

20 It is only by this essential feature that the easier assembly and improvement in operation, referred to introductorily, are achieved.

25 Although the circular wire spring ring in accordance with the invention, as set out in the examples, can also be used for smooth shaft/bore connection, like the circular wire spring ring arrangements already known it can be used to particular advantage in shaft/bore connections which involve an attachment through the agency of serrations or shaft splines.

#### 40 WHAT WE CLAIM IS:—

1. A spring ring made of circular-section wire suitable for securing a first component including a shaft or cylindrical mem-

ber in a corresponding bore provided in a second component, one of said components having a locating groove for retaining the spring ring and the other component having a locking groove so that on sliding said shaft or cylindrical member axially relative to said bore during assembly operation of said components, the spring ring fully retracts into the locating groove and when said locating groove ring and said locking groove are aligned with one another, the spring ring in the locating groove is radially relaxed and engages the locking groove thereby securing together said components, the free end portions of the ring being bent inwardly or outwardly in such a way that they seat against the base of the groove holding the ring substantially concentric in relation to the locating groove, the two bent end portions together constituting about one tenth of the circumferential length of the ring.

2. An assembly including a spring ring as claimed in Claim 1, and said first and second components and wherein the entry side of the bore or the shaft and the extraction side of the locking groove are formed with chamfers which cause the circular wire spring ring to retract fully into the locating groove during assembling or dismantling operation of the components.

3. A spring ring substantially as hereinbefore described with reference to Figures 1 and 2 or Figures 3 and 4 of the accompanying drawings.

4. An assembly according to claim 2 substantially as hereinbefore described with reference to Figures 1 and 2 or Figures 3 and 4 of the accompanying drawings.

PETER ORTON,  
Chartered Patent Agent.

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COMPLETE SPECIFICATION

2 SHEETS

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Sheet 1

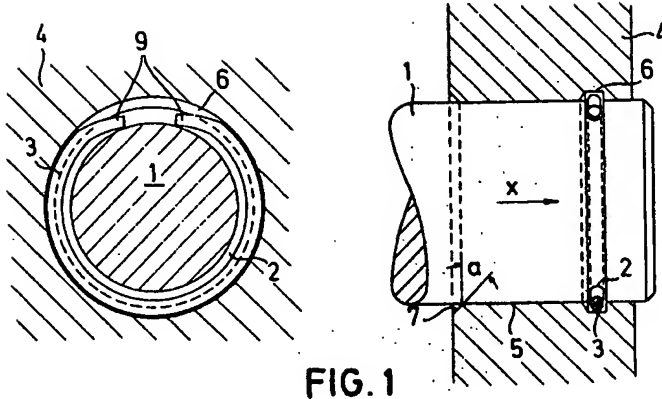


FIG. 1

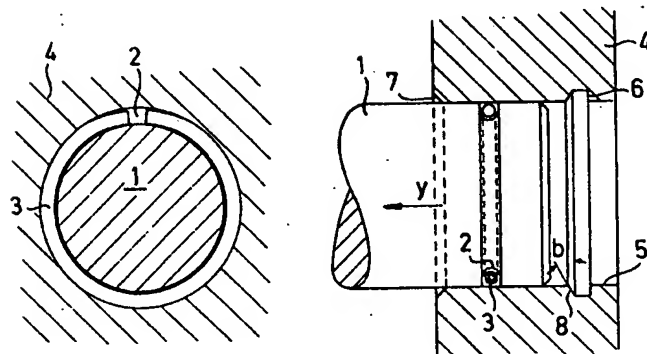


FIG. 2

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COMPLETE SPECIFICATION

2 SHEETS

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Sheet 2

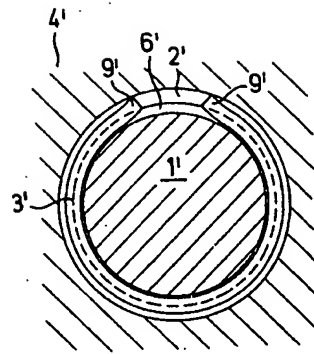


FIG. 3

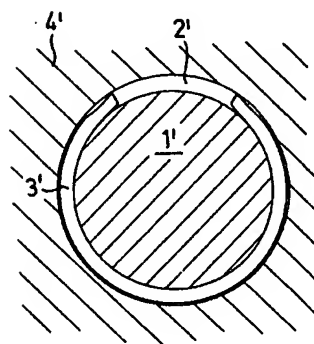
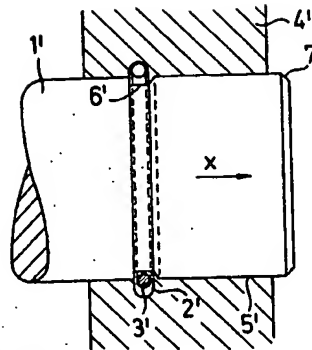


FIG. 4

